

3. *Sporobolus wallichii* Munro ex Trin. in J. Bot. 27: 171. 1889; Hook. f. Fl. Brit. Ind. 7: 248. 1896; Bor, Grass. Bur. Cey. Ind. Pak. 634. 1960. Mathew, Mat. Fl. Tamil. Carnatic 401. 1981. Fig. 3.

Perennial, tufted, 5-15 cm tall, simple or sparingly branched. Leaves linear, 5-15 cm long, acute. Panicles effuse, ovate-oblong, 4.5-8.5 x 2-3 cm, rachis slender, branches filiform, pedicels capillary. Spikelets lanceolate, 1-1.5 mm long. Lower glume oblong, nerveless, truncate. Upper glume oblong-elliptic, obscurely 1-nerved, acute. Lemma ovate-lanceolate, 1-nerved, acute. Palea ovate-oblong, obscurely nerved, subacute. Lodicules minute, stamens 2.

Rare in open grasslands on rocky soil.

Fl. & Fr.: July-September.

Distribution: Kolhapur: Shivaji University

Campus, Salunkhe 8897.

ACKNOWLEDGEMENTS

We thank Dr. T.A. Cope, Royal Botanical Garden, Kew, U.K. and Dr. J.F. Veldkamp, Rijksherbarium, Leiden, The Netherlands for identifying the species..

June 26, 2000

C.B. SALUNKHE

Department of Botany,
Krishna Mahavidyalaya,
Shivnagar 415 108, Maharashtra, India.

S.R. YADAV

Department of Botany,
Shivaji University, Kolhapur 416 004,
Maharashtra,
India.

49. VEGETATION AND PHENODYNAMICS OF WETLANDS OF CENTRAL RAJASTHAN

(With four text-figures)

Studies of low-lying areas, including temporary ponds and pools, were initiated in India by Biswas and Calder (1937), Misra (1946), Ratnam and Joshi (1952), Mall (1961), Vyas (1964), Zutshi (1975), Bhardwaja (1980), Gopal (1986a, b), Bhardwaja and Gena (1987), Sharma K.C. and R. Sharma (1992), Sharma R. and K.C. Sharma (1992), and Anon. (1994). The gently sloping marginal area here exhibits a lush-green carpet of wetland plant species. The shallow middle area remains covered with water during the rainy season, getting exposed gradually to the slushy bottom stage and supporting hygrophilous vegetation during winter. This study reveals that wetlands bear transitional species interspersed with true aquatics, mesic terrestrials, hygro-halophytes, ephemerals, ephemeroids (grasses), poikilohydrics and dried bed plants (Vijay 1999, 2000). In these fluctuating ecosystems, patch dynamics is

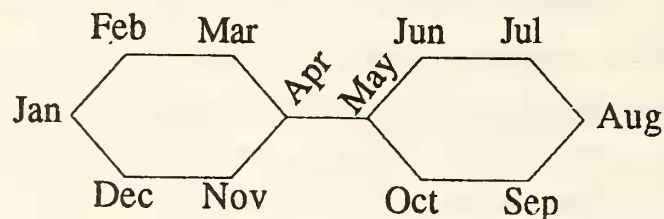
extremely important. Patches of relatively well-delineated areas of vegetation arise from the visible distribution of populations. These patches keep changing with time (Bohmer and Richter 1997). Some unique wetland plants like *Marsilea* spp., *Polygonum* spp., *Ammania baccifera*, *Bacopa monnieri*, *Cyperus* spp., *Scirpus* spp., grow in all zones of wetlands. Zones in vegetational mats occur in patches from the margins towards the centre. In cracks and crevices, *Glinus lotoides* and *Polygonum plebeium* grow profusely. It is well known that wetland plants show fluctuating phenology or phenodynamics, which is totally dependent on the availability of water. Centripetal movement and centrifugal movement of both water and vegetation is an interesting phenomenon of wetlands, and arborescent habit is rare due to fluctuating water levels with slushy beds containing no vegetation. In some small ditches

with slushy beds, dried bed species like *Glinus lotoides*, *Heliotropium* spp., and *Polygonum plebeium* occur. These wetland species growing in temporary ponds show "Terrestrialization": → Aquatic Marsh → Terrestrial (mesic) → Xeric (Kangas 1990).

Phenology (Kumar *et al.* 1980, Reich and Borchert 1982, Vijay 1997, 2000, Singh *et al.* 1998) of wetland plants comprising seed germination (Sg), vegetative growth (Vg), flowering (Fl), fruiting (Fr), seed maturation (Sm) and death (D) pattern were observed and recorded. Phenodynamics of some taxa are described.

Study Sites: The central Aravalli region of Ajmer was the study area. The Aravallis run about 692 km, northeast (near Delhi) to southeast of Gujarat (Palampur). The central Aravalli covers the entire Ajmer region (26° 25'-26° 35' N, 74° 37'-74° 42' E; 481.89 m above msl). The three study sites are Anasagar, Boodha-Pushkar and Lohagal wetland (Fig. 1).

Material and Methods: Vegetation analysis was done during 1997-2000. Field identifications were done with the help of extant Floras (Sharma 1958, Duthie 1903-20, Bhandari 1978, Cook 1996). Diphenyl ring was emphasized for phenological studies as indicated below:



Observations: In all, 102 species belonging to 33 families, comprising grasses, sedges, non leguminous, leguminous plants and lower plants, were recorded in the study area. As the water recedes, the marshy vegetation shows an interesting zonal distribution.

Fig. 2 reveals that the aquatic phase starts in July, wetland stage extends from November to February. The dry phase, beginning at the end

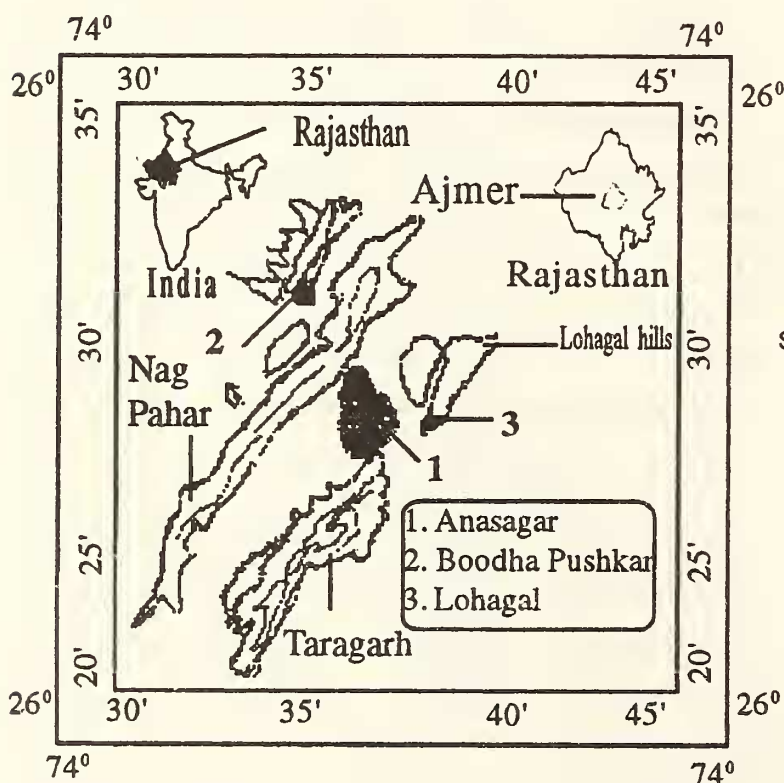
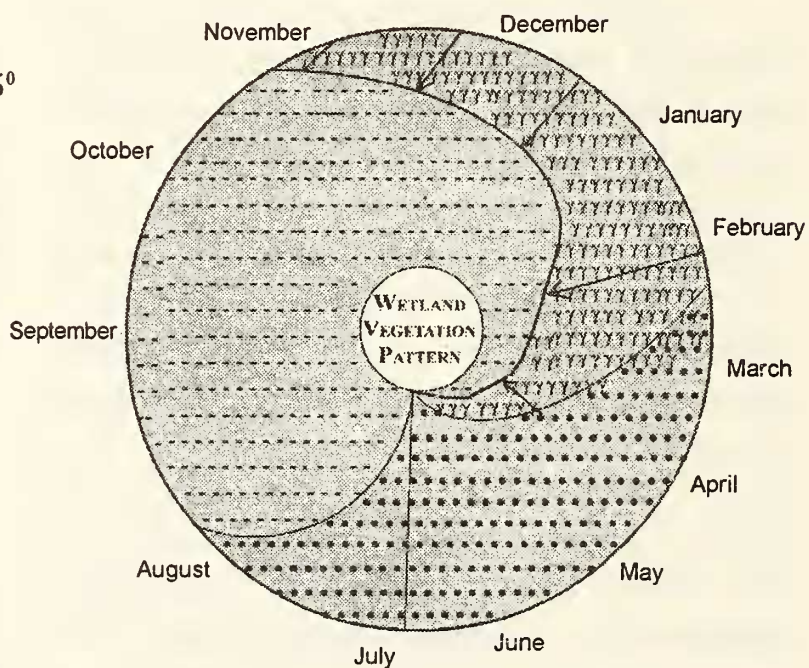


Fig. 1: Map of the study area



Legends: ----- Aquatic Phase;
 γ γ γ Wetland Lush-green Phase;
 ● ● ● - Dry Phase

Fig. 2: Showing Centripetal Movement Leading to Terrestrialization

Table 1: Species composition of Ajmer, central Rajasthan wetland

Sr. No.	Name of Plant	Family	Flowering Season	Locality
(A) Non -leguminous Forbs				
1.	<i>Aerva sanguinolentia</i> (Linn.) Blume, Bijdr	Amaranthaceae	Nov.-Dec.	Lohagal
2.	<i>Aeschynomene indica</i> Linn.	Fabaceae	Sep.-Nov.	Anasagar
3.	<i>Alternanthera paronychioides</i> A. St. Hillaire	Amaranthaceae	Nov.-Mar.	Common
4.	<i>Alternanthera sessilis</i> (Linn.) DC.	Amaranthaceae	Jul.-Oct. Feb.-Apr.	Common
5.	<i>Ammania baccifera</i> Linn.	Lythraceae	Sep.-Mar.	Common
6.	<i>Bacopa monnieri</i> (Linn.) Wettstein	Scrophulariaceae	Nov.-Apr.	Anasagar
7.	<i>Bergia ammanioides</i> Roxb.	Elatinaceae	Oct.-Jan.	Lohagal
8.	<i>Bergia polyantha</i> Sonder	Elatinaceae	Dec.-Mar.	Lohagal
9.	<i>Blumea lacera</i> (Burm.f.) DC.	Compositae	Sep.-Nov.	Common
10.	<i>Caesulia axillaris</i> Roxb.	Asteraceae	Nov.-Jan.	Anasagar
11.	<i>Chenopodium murale</i> Linn.	Chenopodiaceae	Oct.-Feb.	Anasagar
12.	<i>Chrozophora rottelari</i> (Guis) A. Juss ex Spreng.	Euphorbiaceae	Sep.-Dec.	Happy valley
13.	<i>Coldenia procumbens</i> Linn.	Boraginaceae	Jan.-Jun.	Kayad Pond
14.	<i>Cotula hemisphaerica</i> (Roxb.) Wall. ex. Benth. & Hook.	Asteraceae	Sep.-Jan.	Anasagar
15.	<i>Cressa cretica</i> Linn.	Convolvulaceae	Jan.-Jun.	Anasagar
16.	<i>Cyanotis axillaris</i> (Linn.) Sweet.	Commelinaceae	Sep.-Oct.	Lohagal
17.	<i>Dentella repens</i> (Linn.) Frost.	Rubiaceae	Dec.-Feb.	Anasagar
18.	<i>Digera arvensis</i> Linn.	Amaranthaceae	Aug.-Jan.	Anasagar
19.	<i>Dopatrium junceum</i> (Roxb.) F. Hamilton ex Benth	Scrophulariaceae	Sep.-Dec.	Common
20.	<i>Eclipta prostrata</i> (Linn.) Linn.	Asteraceae	Jul.-Jan.	Common
21.	<i>Gisekia pharnaeoides</i> Linn.	Molluginaceae	Sep.-Jan.	Anasagar & Boodha Pushkar
22.	<i>Glinus lotoides</i> Linn.	Molluginaceae	Feb.-Jun.	Common
23.	<i>Gnaphalium indicum</i> Linn.	Asteraceae	Feb.-Jun.	Kayad Pond
24.	<i>Gnaphalium luteo-album</i> Linn.	Asteraceae	Nov.-Mar.	Common
25.	<i>Gnaphalium polycaulon</i> Pers.	Asteraceae	Sep.-Mar.	Foysagar
26.	<i>Gnaphalium pulvinatum</i> Delile.	Asteraceae	Mar.-May	Ghughra
27.	<i>Grangea maderaspatana</i> (Linn.) Poir.	Asteraceae	Dec.-Mar.	Anasagar
28.	<i>Heliotropium curassavicum</i> Linn.	Boraginaceae	Sep.-Jan.	Ghughra
29.	<i>Heliotropium indicum</i> Linn.	Boraginaceae	Sep.-Jan.	Anasagar
30.	<i>Heliotropium strigosum</i> Willd.	Boraginaceae	Oct.-Dec.	Anasagar
31.	<i>Heliotropium supinum</i> Linn.	Boraginaceae	Jan.-Dec.	Anasagar
32.	<i>Heliotropium ovalifolium</i> Forsk.	Boraginaceae	Mar.-Jun.	Ghughra
33.	<i>Hoppea dichotoma</i> Willd.	Haloragaceae	Oct.-Dec.	Lohagal
34.	<i>Hygrophila schulli</i> (F. Hamilton) M.R. et S.M. Almeida	Acanthaceae	Sep.-Dec.	Ghughra
35.	<i>Ipomea aquatica</i> Forsk.	Convolvulaceae	Oct.-Jan.	Ajmer city
36.	<i>Ipomea fistulosa</i> Martius ex. Choisy	Convolvulaceae	Oct.-Jan.	Ajmer city
37.	<i>Juncus bufonius</i> Linn.	Juncaceae	Sep.-Feb.	Common
38.	<i>Justicia quinqueangularis</i> J.G. Konig ex Roxburgh	Acanthaceae	Dec.-Feb.	Common
39.	<i>Launaea procumbens</i> (Roxb) Ramayya & Rajgopal	Asteraceae	Mar.-Apr.	Common
40.	<i>Limnophila heterophylla</i> (Roxb.) Benth	Scrophulariaceae	Oct.-Apr.	Ghughra
41.	<i>Malva parviflora</i> Linn.	Malvaceae	Oct.-Feb.	Lohagal
42.	<i>Mentha</i> sp. (?)	Labiatae	Nov.-Mar.	Boodha Pushkar
43.	<i>Monochoria vaginalis</i> (N.L. Burman) Kunth	Pontederiaceae	Dec.-Mar.	Anasagar
44.	<i>Nicotiana plumbaginifolia</i> Viv.	Solanaceae	Nov.-Mar.	Happy Valley

Table 1: Species composition of Ajmer, central Rajasthan wetland (contd.)

Sr. No.	Name of Plant	Family	Flowering Season	Locality
45.	<i>Oldenlandia diffusa</i> (Willdenow) Roxb.	Rubiaceae	Sep.-Dec.	Lohagal
46.	<i>Oxalis corniculata</i> Linn.	Oxalidaceae	Dec.-Feb.	Anasagar
47.	<i>Peplidium maritimum</i> (Linn. f.) Aschers.	Scrophulariaceae	Dec.-Mar.	Anasagar
48.	<i>Phyla nodiflora</i> (Linn.) Greene	Verbenaceae	Oct.-Mar.	Common
49.	<i>Polygonum glabrum</i> Willd.	Polygonaceae	Jul.-Oct.	Boodha Pushkar
50.	<i>Polygonum plebeium</i> Willd.	Polygonaceae	Oct.-Nov.	Common
51.	<i>Portulaca meridiana</i> Linn.	Portulacaceae	Sep.-Jan.	Anasagar
52.	<i>Portulaca oleracea</i> Linn.	Portulacaceae	Sep.-Jan.	Lohagal
53.	<i>Portulaca quadrifida</i> Linn.	Portulacaceae	Sep.-Jan.	Anasagar
54.	<i>Potentilla supina</i> Linn.	Rosaceae	Jan.-Apr.	Common
55.	<i>Pulicaria foliosa</i> A.P. de Condolle	Asteraceae	Sep.-Nov.	Anasagar
56.	<i>Ranunculus scleratus</i> Linn.	Ranunculaceae	Oct.-Dec.	Anasagar
57.	<i>Rumex dentatus</i> Linn.	Polygonaceae	Sep.-Dec.	Anasagar
58.	<i>Spergula fallax</i> (Lowe.) Krause	Caryophyllaceae	Nov.-Mar.	Anasagar & Lohagal
59.	<i>Sphaeranthus indicus</i> Linn.	Asteraceae	Jan.-Apr.	Anasagar
60.	<i>Suaeda fruticosa</i> (Linn.) Forsk.	Chenopodiaceae	Mar.-Jun.	Anasagar
61.	<i>Tamarix dioica</i> Roxb.	Tamaricaceae	Dec.-Jan.	Anasagar
62.	<i>Trianthema crystallina</i> Roxb.	Aizoaceae	Oct.-Feb.	Anasagar
63.	<i>Trianthema portulacastrum</i> Linn.	Aizoaceae	Oct.-Feb.	Boodha Pushkar
64.	<i>Typha domingensis</i> Persoon	Typhaceae	Oct.-Feb.	Anasagar
65.	<i>Typha elephantiana</i> Roxb.	Typhaceae	Oct.-Feb.	Common
66.	<i>Verbascum chinense</i> (Linn.) Santapau	Scrophulariaceae	Jan.-Apr.	Common
67.	<i>Xanthium strumarium</i> Linn.	Asteraceae	Sep.-Feb.	Common
(B) Leguminous Forbs				
1.	<i>Sesbania bispinosa</i> (Jacq.) W.F. Wight	Fabaceae	Sep.-Nov.	Anasagar
2.	<i>Trigonella occulta</i> Raffenu-Delile.	Papilionaceae	Feb.-Mar.	Common
(C) Grasses				
1.	<i>Arundo donax</i> Linn.	Poaceae	Sep.-Dec.	Pal Beechla
2.	<i>Brachiaria ramosa</i> (Linn.) Stapf	Poaceae	Aug.-Oct.	Common
3.	<i>Cenchrus biflorus</i> Roxb.	Poaceae	Aug.-Oct.	Common
4.	<i>Chloris virgata</i> Sw.	Poaceae	Aug.-Oct.	Common
5.	<i>Cynodon dactylon</i> (Linn.) Pers.	Poaceae	Jan.-Dec.	Common
6.	<i>Dicanthium annulatum</i> (Forsskal) Stapf	Poaceae	Sep.-Feb.	Common
7.	<i>Digitaria ciliaris</i> (Rotzius) Koeler	Poaceae	Nov.-Dec.	Common
8.	<i>Digitaria setigera</i> Roth. ex Roemer et. Schulf.	Poaceae	Sep.-Dec.	Common
9.	<i>Echinochloa colonum</i> (Linn.) Link.	Poaceae	Sep.-Feb.	Common
10.	<i>Eragrostis pilosa</i> (Linn.) Palisot de Beauvois	Poaceae	Jan.-Dec.	Common
11.	<i>Fimbristylis tomentosa</i> Vahl	Poaceae	Nov.-Jan.	Common
12.	<i>Paspalidium geminatum</i> (Forsk.) Stapf	Poaceae	Jan.-Oct.	Boodha Pushkar & Anasagar
13.	<i>Perotis indica</i> (Linn.) O. Ktze.	Poaceae	Jan.-Dec.	Common
14.	<i>Phragmites vallatoria</i> (Linn.) Veldkomp.	Poaceae	Aug.-Jan.	Ajmer city
15.	<i>Poapalustris</i> Linn.	Poaceae	Nov.-Dec.	Common
16.	<i>Saccharum bengalense</i> Retz.	Poaceae	Jan.-Dec.	Anasagar
17.	<i>Setaria verticillata</i> (Linn.) P. Beauv.	Poaceae	Aug.-Oct.	Common
18.	<i>Polypogon monspeliensis</i> (Linn.) Desf.	Poaceae	Dec.-Feb.	Anasagar

Table 1: Species composition of Ajmer, central Rajasthan wetland (contd.)

Sr. No.	Name of Plant	Family	Flowering Season	Locality
(D) Sedges				
1.	<i>Cyperus compressus</i> Linn.	Cyperaceae	July-Oct.	Common
2.	<i>Cyperus diformis</i> Linn.	Cyperaceae	Oct.-Nov.	Common
3.	<i>Cyperus rotundus</i> Linn.	Cyperaceae	Oct.-Mar.	Common
4.	<i>Cyperus setaceus</i> Retzius	Cyperaceae	Nov.-Mar.	Common
5.	<i>Cyperus triceps</i> (Rottb.) Endlicher	Cyperaceae	Sep.-Mar.	Common
6.	<i>Cyperus alopecuroides</i> Rottb.	Cyperaceae	Oct.-Mar.	Anasagar
7.	<i>Cyperus involucratus</i> Rottb.	Cyperaceae	Sep.-Nov.	Common
8.	<i>Cyperus atkinsonii</i> C.B. Clarke	Cyperaceae	Oct.-Mar.	Common
9.	<i>Cyperus bulbosus</i> Vahl.	Cyperaceae	Oct.-Mar.	Boodha Pushkar
10.	<i>Eleocharis acutangula</i> (Roxb.) Schultes	Cyperaceae	Sep.-Feb.	Common
11.	<i>Scirpus lateriflorus</i> Gmel.	Cyperaceae	Aug.-Dec.	Anasagar
(E) Archegoniates Cryptogams				
1.	<i>Equisetum ramosissimum</i> Desfontaines	Equisetaceae		Nasirabad Valley
2.	<i>Marsilea aegyptiaca</i> Willdenow	Marsileaceae		Lohagal
3.	<i>Marsilea minuta</i> Linn.	Marsileaceae		Anasagar
4.	<i>Riccia crystallina</i> (?)	Ricciaceae		Anasagar

of February, continues till June. The maximum vegetation occurs in medium water conditions when terrestrialization is initiated and sequence of vegetation is affected. The gentle sloping marginal zone exhibits a carpet of wetland species, with 'terrestrialization' occurring at the middle zone, which is covered with water during the rainy season, gradually getting exposed in winter, supporting lush-green marshy vegetation. During the dry months the water level recedes further and at its minimum the ponds and puddles support characteristic vegetation consisting of *Glinus lotoides*, *Alternanthera sessilis*, *Polygonum plebeium*, *Paspalidium geminatum*, *Ammania baccifera*, *Eclipta prostrata*, *Gnaphalium pulvinatum*, *Bacopa monnieri*, *Phyla nodiflora*, *Grangea madraspatana*, *Polypogon monspeliensis*, *Portulaca* spp., and *Cynodon dactylon*. Some hygro-halophytes, such as *Heliotropium supinum*, *Suaeda fruticosa* and *Cressa cretica* (Table 1), also appear on the exposed soil.

Phenodynamics: Phenological observations of *Heliotropium curassavicum*, *Glinus lotoides*, *Cressa cretica* and *Ammania baccifera*

inhabiting the wetlands were recorded during the study period (1997-99), (Figs 4A-D).

From Fig. 4 (A-D) it is evident that phenology fluctuates with the availability of water, humidity and temperature. Striking phenovariations/pheno-rhythms were observed for the period under study, which emphasizes variations in phenophases corresponding to climatic variations in the terrestrialization process. It may be mentioned that 1997 was a period of excess rainfall at Ajmer, as indicated in the ombrotherms for 1997-99 (Fig. 3).

A. Heliotropium curassavicum – a soft soil plant, with germination of seed generally in November and December. But in 1997, no germination occurred due to excessive flooding. In April and May 1998, germination occurred, but flowering, fruiting and seed maturation was not completed because of heavy rainfall in July (Fig. 4A)

B. Glinus lotoides – A dry bed or cracked soil plant of the wetlands. It showed seed germination only in June 1998. In 1997-98 and up to February 1999, *Glinus lotoides* was totally absent from these sites (Fig. 4B)

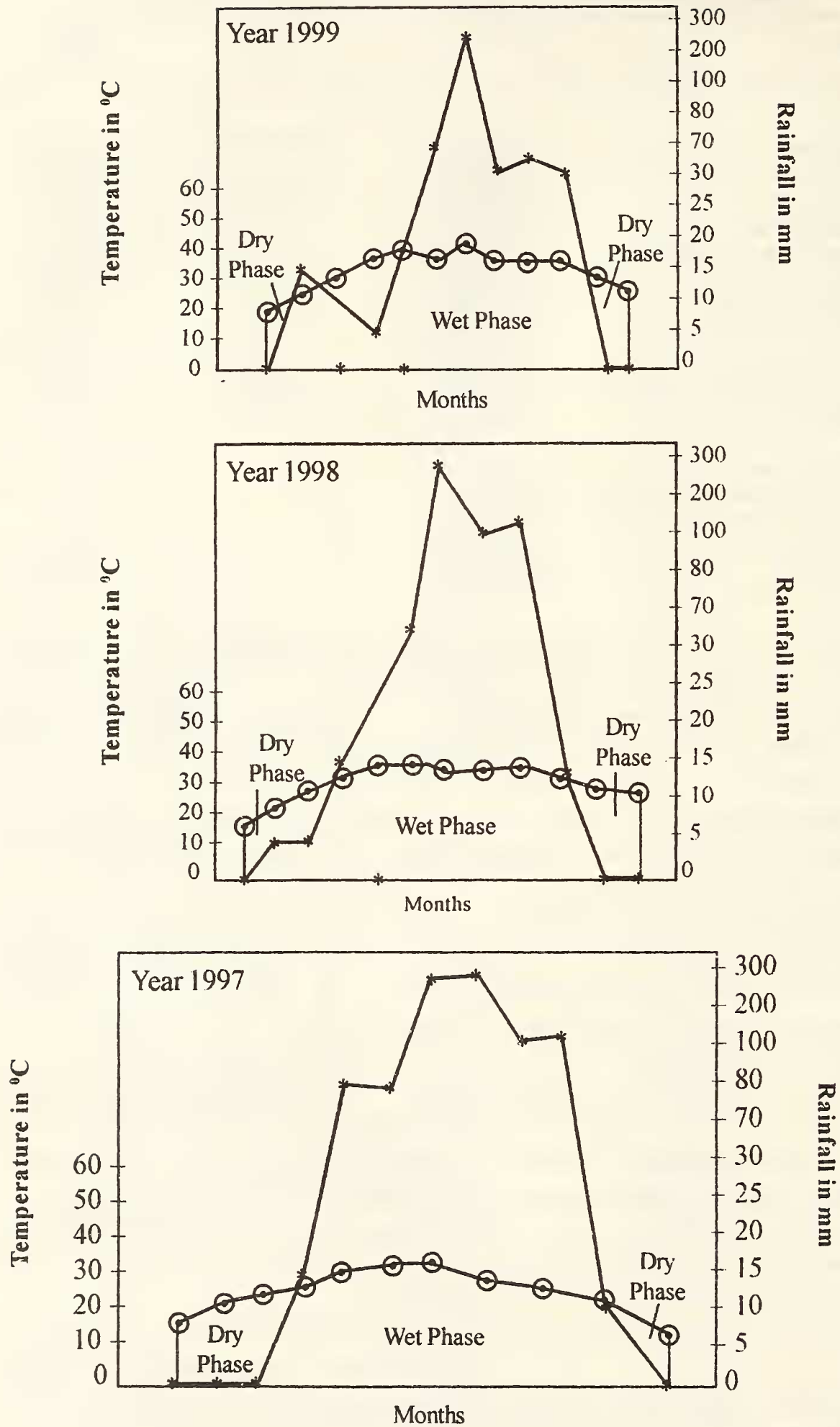
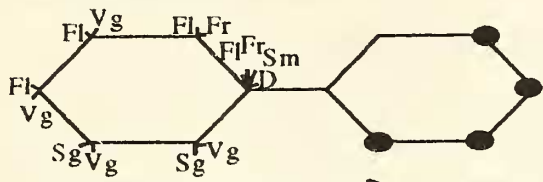


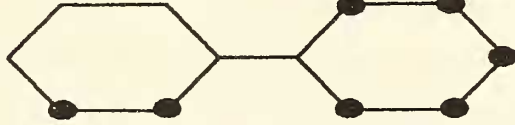
Fig. 3: Ombrothermic diagrams showing wet and dry phase during the study period

(A) *Heliotropium curassavicum*

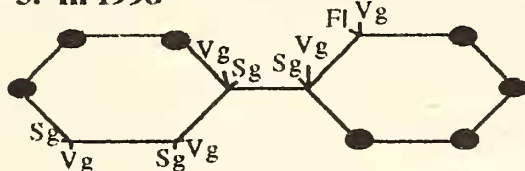
1. In normal condition



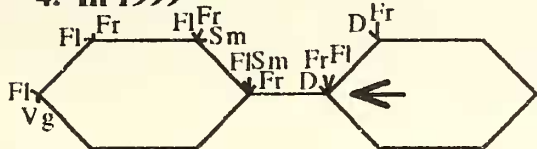
2. In 1997



3. In 1998

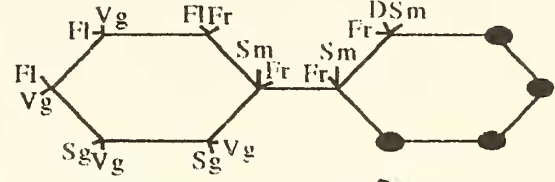


4. In 1999

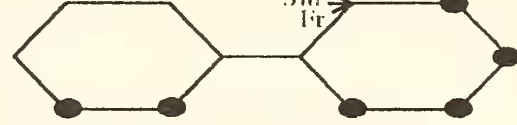


(B) *Glinus lotoides*

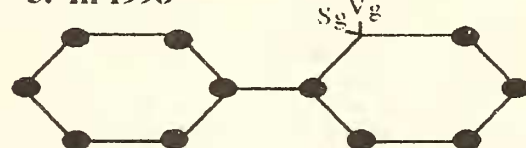
1. In normal condition



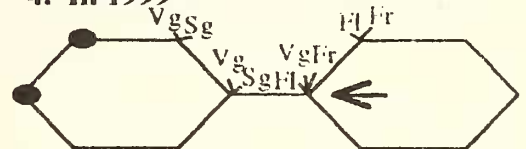
2. In 1997



3. In 1998

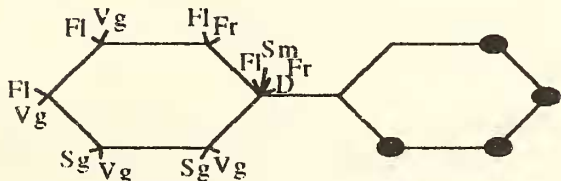


4. In 1999



(C) *Cressa cretica*

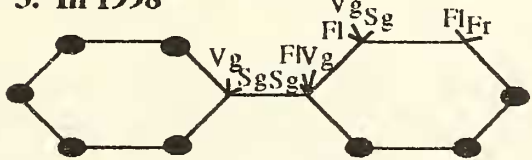
1. In normal condition



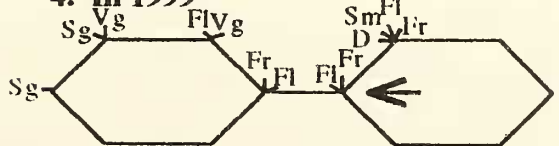
2. In 1997



3. In 1998

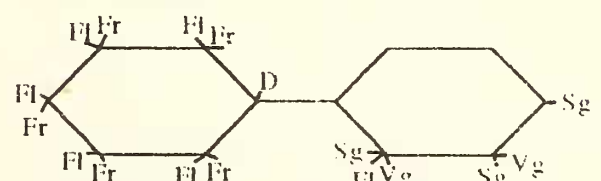


4. In 1999

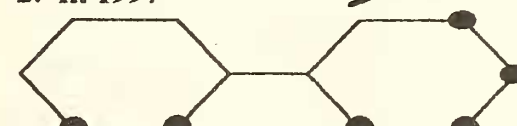


(D) *Ammania baccifera*

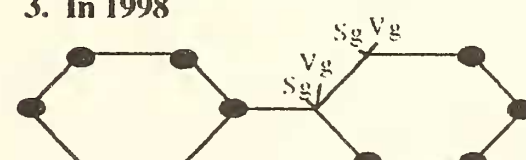
1. In normal condition



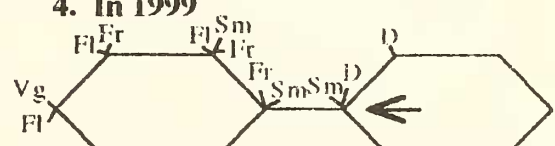
2. In 1997



3. In 1998



4. In 1999



Abbreviations: Sg-Seed germination; Vg-Vegetative growth; Fl-Flowering; Fr-Fruiting; Sm-Seed maturation; D-Death; ● - Water Flooding

Fig. 4: A-D Phenodynamics of some Wetland plants

C. Cressa cretica – Under normal conditions, phenology starts from November, but in 1997 germination did not occur the whole year due to flooding and continued till March 1998. In April 1998, seed germination and vegetative growth started, but flowering and fruiting did not occur due to flooding till December 1998. Seed germination began only in January 1999 (Fig. 4C)

D. Ammania baccifera – Characterized by various colours during growth with seed germination in August. In 1997, however, no seed germination occurred in August and this continued till April of the next year, i.e. 1998. Germination took place in May 1998, and reflooding in July 1998 permitted the plant to reappear in November 1998 (Fig. 4D).

Discussion: Wetlands are highly productive ecosystems with prolific biodiversity. They are significant in terms of water purification, microclimatic regulation, locking and storing nutrients, recharging of water table and as habitats for wildlife. The extant

degradation of wetlands calls for intensive ameliorative measures. Striking pheno-variations and pheno-rhythms were observed, indicating the impact of microclimatic factors.

Cultivation, human activities and land encroachment for building purposes poses various threats to wetland vegetation. Ponds, puddles and water reservoirs supporting these wetland plants are gradually being eliminated in the study area, due to cultivation at Boodha Pushkar, urbanisation, waste disposal and water pollution due to professional washing at Anasagar, and growth of *Prosopis chilensis* at Lohagal site. This calls for a concerted effort to save wetland vegetation in and around cities like Ajmer. We hope that this study will succeed in drawing attention to this need.

October 1, 2001

S.K. VIJAY

T.N. BHARDWAJA

Department of Botany

M.D.S. University, Ajmer 305 001,

Rajasthan, India.

REFERENCES

- *ANON. (1994): Wetland mapping. In: Wetlands of India (Project Report), (Eds.: Garg, J.K., T.S. Singh and T.V.R. Murthy). Pp. 240. Space Applications Centre (ISRO), Ahmedabad.
- BHANDARI, M.M. (1978): Flora of the Indian Desert. MPS Repros, Jodhpur. Pp. 1-435 (2nd edn, 1990).
- BHARDWAJA, T.N. (1980): Recent advances in our knowledge of the water fern *Marsilea*. In: Aspects of Plant Sciences III. (Ed.: Bir, S.S.) Today & Tomorrow's Publ., New Delhi, pp. 39-62.
- BHARDWAJA, T.N. & C.B. GENA (1987): Status survey of pteridophytic flora of Rajasthan with special reference to endangered ferns and fern allies. *Indian fern Journal* 4: 47-50.
- BISWAS, K. & C.C. CALDER (1937): Handbook of common water and Marsh plants of India and Burma. Govt. of India Publication, Delhi.
- BOHMER, H.J. & MICHAEL RICHTER (1997): Regeneration of plant communities - An attempt to establish a typology and azonal system. *Plant research and development* 45: 74-88. Inst. of Scientific Cooperation. Tübingen Federal Republic of Germany.
- COOK, C.D.K. (1996): Aquatic and wetland plants of India. Oxford University Press. Delhi. pp. 385.
- DUTHIE, S. (1903-20): Flora of upper Gangetic plain. Vol. I-III, Repr. Ed. 1960. Botanical Survey of India, Howrah.
- GOPAL, B. (1986a): Vegetation dynamics in temporary and shallow fresh water habitats. *Aquat. Bot.* 23: 391-396.
- GOPAL, B. (1986b): Wetland Ecosystem: An appraisal. Veroff. Geobot. Inst. ETH. Stiftung. Rubel. Zurich. Pp. 362-371.
- KANGAS, P.C. (1990): Long-term development of Forested wetlands, Ecosystem of the world 15. Elsevier Science Pub. Amsterdam, Netherlands.
- *KUMAR, A., P. KUMAR & M.C. JOSHI (1980): Phenological observations on herbaceous vegetation around Pilani. *Indian J. Ecol.* 7: 84-87.
- MALL, L.P. (1961): Ecology of drying ponds. *J. Indian bot. Soc.* 40: 139.
- *MISRA, R. (1946): A study in the ecology of low lying lands. *Indian Ecol.* 1: 45-52.

- *RATNAM, B.V. & M.C. JOSHI (1952): An ecological study of vegetation near about a temporary pond in Pilani. *Proc. Rajasthan Acad. Sci.* 3: 45-59.
- *REICH, P.B. & R. BORCHERT (1982): Phenology and ecophysiology of the tropical tree, *Tabebuia neochrysantha* (Bignoniaceae). *Ecology*: 294-299.
- SHARMA, K.C. & R. SHARMA (1992): Trophic evaluation of an urban wetland of Ajmer, Rajasthan. Inteclo's IV International Wetland Conference, Ohio State University, Columbus, Ohio, USA.
- SHARMA, RENU & K.C. SHARMA (1992): Floristic diversity of wetlands of Aravalli ecosystem, a survey of Anasagar lake of Ajmer. National Seminar on Ecological Restoration of Aravalli Hill ecosystems of Rajasthan at Ajmer. DST, Jaipur.
- SHARMA, V.S. (1958): The flora of Ajmer. *J. Bombay nat. Hist. Soc.* 55: 129-141.
- *SINGH, A., P.K. RALHAN & R.P. SINGH (1998): Phenological studies on conditioned stocks of Shisham (*Dalbergia sissoo* Roxb.). *Indian J. Ecology* 26(1): 114-122.
- VIJAY, S.K. (1997): Phenological observations of some rare vascular plants of Pushkar Valley, Ajmer (Abstract). Proc. of Nat. Conf. on Environment & Ecodevelopment of Pushkar Valley of Rajasthan. Pp. 11.
- VIJAY, S.K. (1999): Ecomorphological investigations of wetland plants in selected sites of Ajmer with special reference to Amphibiousness (Abstract). International Conference on Tropical Aquatic Ecosystems, Nainital, India. Pp. 137.
- VIJAY, S.K. (2000): Phenological observations of marshy wetland flora of Ajmer, Central Rajasthan (Abstract). Proc. of the 87th ISCA Pune. Pp 74-76.
- VYAS, L.N. (1964): A study of hydrophytes and marsh plants of Alwar and environs. *JIBS* 43: 17-30.
- ZUTSHI, D.P. (1975): Association of macrophytic vegetation of Kashmir lakes. *Vegetatio* 30: 61-62.

*Not seen in original.

50. *TYPHONIUM HORSFIELDII* (MIQ.) STEENIS, FAMILY ARACEAE, A NEW REPORT FOR INDIA

(With one text-figure)

While revising the Indian Araceae, it was found that a specimen at CAL which had been collected in Mizoram by B. Godfrey and labelled as *Arisaema tortuosum* (Wall.) Schott var. *curvatum* (Roxb.) Engl. had been later determined as *Typhonium horsfieldii* (Miq.) Steenis by Nicolson, a well-known aroidologist. A perusal of literature reveals that this species is confined to Java in Indonesia. As the specimen in question is from Mizoram, the species becomes an addition to the flora of India. A detailed description and an illustration (Fig. 1) are provided to facilitate identification.

Typhonium horsfieldii (Miq.) Steenis in Bull. Jard. Bot., Buitenzorg Ser. 3, 17: 403. 1948; Backer & Bakh. f., Fl. Java 3: 123. 1968. *Sauromatum horsfieldii* Miq., Fl. Ind.-Bat. 3: 196. 1856; Engl. in A. DC., Monogr. Phan. 2: 571. 1879. Type: Java (U). *Typhonium fallax* N.E. Br. in J. Linn. Soc., Bot. 18: 260. 1880; Engl., Pflanzenr. (IV. 23 F) 73: 121, f. 17 F - N. 1920.

Heterostalis pedata Schott in Ann. Mus. Bot. Lugduno-Batavum 1: 278. 1864, non *Typhonium pedatum* Schott 1857. *Typhonium pedatum* sensu Engl. in A. DC., Monogr. Phan. 2: 613. 1879, non Schott 1857.

Cormous herb; corm c. 0.9 x 0.8 cm, subglobose. Cataphylls 3-3.5 cm long. Leaves pedatisect; petioles 10-40 cm long, sheathing; leaflets 7-9, sessile, lanceolate, acuminate; middle leaflet 5.5-7.5 x 0.6-1 cm; lateral leaflets gradually becoming smaller, 1.2-5.5 cm long. Peduncle 4-20 cm long; spathe 8-10 cm long; tube 2-3 cm long, oblong, convolute; limb 6-7 x 2-2.5 cm, oblong-lanceolate, cuspidate. Spadix 5.8-10 cm long. Pistillate-flowered portion 0.2-1 x 0.4-0.6 cm. Neuter-flowered portion 2-2.2 cm long followed by stipe c. 7 mm long. Staminate-flowered portion 0.7-1 x c. 0.3 cm, terminating in a stipitate appendix. Pistillate flowers c. 1 x 0.5-0.8 mm, dense; ovary ovoid, 2-ovuled; stigma capitate, coronate. Neuters